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Report

REPORT

ACCOMPANYING

PLANS FOR THE IMPROVEMENT OF THE VENTILATION AND HEATING

OF THE

HALL OF REPRESENTATIVES.

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THAT to warm a room by direct radiation, and supply it by cool, fresh, invigorating air for breathing, is necessary for health and comfort, is now so generally admitted, that it scarcely needs any argument in its favor.

The great wonder now is, that so many very eminent engineers should have persevered so long directly in the face of continued failures in attempting to warm and ventilate large buildings by forcing in currents of over-heated, debilitating air, at the same time allowing all the walls and solid objects in the room to be colder, and absorbing the animal heat—the very essence of life—from the inmates. The cause of these universal failures is well explained by the simple physiological fact that we give off twice the quantity of carbonic acid—or, in other words, that we live twice as fast, and can do double the amount of work, and need as much again food, when we are breathing air from 10° to 20°, that we do when breathing air from 90° to 100°.

This is well illustrated on any bright, clear, cold day; the warm rays of the sun, which are frequently of sufficient power to boil water, are very agreeable as they fall upon us, while we are surrounded with and breathing the cold and invigorating air, perhaps at 20° or 30°; vigorous bodily or mental exercise is then much easier than on a sultry day in summer.

How entirely different are the conditions now existing in the House of Representatives! The air is taken in at the basement, down through the cellar; from there forced up by the fan through an immense stack of rusty, dirty iron pipes, coated by many years' accumulation of particles of decaying animal and

vegetable matter, roasted up afresh every day; from thence driven through a labyrinth of uncleaned horizontal air-ducts, filled with the moulding and decaying dirt of several years' accumulation; and finally driven through the uncleaned spittoons arranged all over the floor of the house; issuing into the room at a temperature of from 100° to 120°—a warm, filthy, disgusting mass for the members to breathe.

I think it is time this was changed.

Not only does the application of direct radiation furnish a much more wholesome and agreeable atmosphere, but it at once relieves us of much of that trouble about the proper circulation of the fresh and foul air that has so vexed the hot-air engineers. It enables us to dispense with those expensive nuisances—The Fans.

Most of the members, no doubt, have noticed the disagreeable smells and heat arising from the engine-rooms and fans, and which fill the western stairways, especially on the side of the Senate. At times in the summer, when the doors are open, and the wind from the south, this unpleasant odor and heat may be noticed on the east front, having filled the whole stairway, passed across the Senate Chamber, and out the front.

In summer this current adds several degrees of heat to the temperature of the upper rooms.

By dispensing with the engines and fans, a great gain would be at once effected both in economy and comfort.

I know very well that many prominent engineers insist upon it that the fan is necessary to secure at all times the proper circulation of air. When dependence is placed exclusively upon warming the whole building by currents of heated air (which is all wrong), there may be some excuse for the use of the fan; but I think even then the heated shaft is more efficient.

All question is avoided, however, as to the necessity for its use where we heat principally by direct radiation. The idea of heating by direct radiation is by no means a new one; it is much older than heating by hot-air currents.

But perfect success depends greatly upon the proper and skilful arrangement of the heating surfaces in combination with the necessary supply of fresh air; and the removal of foul so arranged that a uniform movement of air shall be secured over the whole building without perceptible draughts.

Probably four-fifths, or not unlikely nine-tenths of all the air entering the buildings as now arranged, comes in through the doors and windows; the other one-fifth or tenth being driven in by the fan, frequently at a high temperature, to counteract the cooling effect of that entering by the doors and windows.

Now by placing the heating surface directly under the external windows, that really becomes the very best place for the supply of fresh air.

It enters then directly from the external atmosphere, thus avoiding the great objections to long uncleaned air ducts.

By leaving the heating surface exposed, we get the greatest direct radiation just where it is most needed, immediately under the cold window, the two extremes thus neutralizing each other.

This arrangement was suggested by me, adopted by the supervising architect, and has been tested in the north wing of the Treasury, and with subsequent modifications, in New York. It is found to work admirably. Those unpleasant cold draughts so commonly felt near windows are thus entirely prevented.

The plans accompanying this report show where it is proposed to place the heating surface in the various stories.

I was surprised and very much pleased to find how readily an entire modification of the heating and ventilation could be effected without disturbing the general arrangement of the building in any important particular.

It will be observed by reference to the plans, that it is proposed to completely reverse the direction of the current at the floor, and instead of the fresh (?) air entering through the uncleaned spittoons, as at present, the foul air will be drawn off there.

This change can be effected without at all interfering with the present arrangement of the supply by the fan, so that it may be reversed in 15 minutes, and the fan can be used every alternate day, until it is fully proven to be worse than useless.

It is proposed not to touch the present arrangement in any manner, but to leave the whole just as it is, to be used at any time to illustrate more strikingly the contrast.

The old material would be of little value if removed.

"*Supply of Fresh Air.*"

In previous reports much stress has been laid on the source of supply for the fresh air.

Most of them contemplate conducting through underground passages of considerable length. I endeavor to avoid all underground passages wherever possible, as the difficulty of keeping them sweet and pure is so great that it is seldom done in practice.

Any damp place excluded from the direct disinfecting and purifying rays of the sun is liable to become mouldy, and this mould of such places is now considered to be the cause of miasmatic fevers.

When it is proposed to force the air over the entire building by fans from one or two points, this single supply may be of considerable importance; but with the heating surface distributed around the entire building, as proposed by us, this difficulty is entirely overcome at once, and we admit the pure external air directly into the building without the least contamination.

And for the Hall of Representatives we propose taking the pure air from the very top of the building—a higher point than proposed by any of the other parties.

This fresh air will enter through the numerous perforations of the panels in the ceiling, and being *cooler*, will fall, gently diffused over the room.

And as a large proportion of the heat will be derived from the direct radiation of the warmed walls, the effect will be very similar to that of a cool, bright day in spring or autumn.

Many persons suppose that a current of cold air on the head would be unbearable. This depends entirely on attending circumstances.

I have frequently stood on the hot plates in the hold of a steamship, with my back to the hot boiler, and allowed a perfect torrent of very cold air to pour down upon me; the effect was delightful, as long as my feet and back were kept thoroughly warm. But if you are surrounded by cold walls, and a cold current strikes your back, especially between the shoulders, or makes the feet cold, that is very dangerous.

"*Removal of Foul Air.*"

With many of the projects for ventilation, this seems to have been the primary object, but it is really secondary, the supply of the fresh air being of the first and greatest importance.

If a building is constantly overflowed with an abundance of cool, fresh, invigorating air, and has an ample supply of heat from well-diffused heating surfaces around the exterior to prevent the inconvenience of cold draughts, there will be but little difficulty about the escape of the foul air.

It is better, however, and makes a more perfect arrangement, to provide for an ample and regular removal of foul air sufficient to keep the rooms perfectly pure, even should all the windows and doors be closed for a long time continuously.

By reference to the accompanying plans, it will be seen that this is fully provided for.

In the first place, it is necessary to remove with care all offensive smells; with the present arrangement, the heat, gases, and odors from the boiler and engine-rooms are about the greatest nuisances in the building. Then the heat and smell from the kitchen and restaurant in the cellar, as well as from the water closet, permeate the whole building.

All these would be carefully removed by the four large shafts connected with the smoke-stacks from the boilers. These are now doing very efficient service; but the odors from the boiler-house, &c., ascend the main stairs, flow through the Hall of Representatives, across the attic, down two of these flues, to the bottom of the cellar again, and up the other two, and finally escape.

Rather a circuitous route to make the foul air travel. Reminds one of the undertaker who carried the body of a person having died with the smallpox all through the town, to show the people how careful he was in burying such. Instead of this, we would propose, as shown in the accompanying plan, to open all four of these large flues directly from the cellar and engine-house, using three for the ventilation of the latter, and one for the kitchen and water closets; this will double the capacity of these flues, as the two now used for bringing the air down from the attic would be capped out above the roof, and make most efficient exhaust flues from the cellar and basement. The two on the eastern side would require a steam-coil or furnace in each, to increase the draught.

The heat from the boilers causes an excellent draught in the others, as may be easily seen at any time on examination.

The capacity of these flues at 50 square feet area, with a velocity of five feet per second, would give a discharge of 15,000 cubic feet per minute, which would be about equal to the working capacity of the smaller fan.

Now, with this large exhaust from the cellar and basement, removing these offensive smells, one-half of the present difficulties would be removed. There would be much of the time a descending current on the main stairs, where there is now an ascending current. The space behind the main stairs, on the east front, should be one-half used for a ventilating shaft from the cellar and basement at that end of the building, and the other half for an air-duct for forcing up cooled air for summer, and for a hoist-way for ice, &c. The space behind the main stairs on the west, where the steam-coils are, should be used as a ventilating shaft exclusively, for the discharge of foul air from the floor of the house. By shutting off all supply from below, and opening an outlet above, as shown on the accompanying section, the whole current would be at once reversed, so that, instead of the current entering at that point, the foul air would be drawn off there, as it should be. This flue is 6 × 30, giving an area of 180, which, with a velocity of four feet per second, would discharge over 40,000 feet per minute. This, in addition to the large amount that would be escaping from the ceiling at all times, and especially when the gas was lighted, would be double the quantity that would be generally required, and consequently must be throttled much of the time. It is proposed to alter this main shaft in such a manner that it can be replaced in a short time, so that, instead of its being an exhaust shaft, it will be a supply shaft, just as at present.

Where the fresh air supplied is colder than the temperature of the room, and the heat derived from direct radiation, a much less number of cubic feet answers for a healthful respiration; yet it will be seen we have a capacity for the discharge of air double the amount required under any circumstances whatever.

"Supply of Cold Air for Summer."

By removing the engines and fans, or allowing them to remain cold, one-half the trouble in this respect will be obviated, and by ceiling the space under the

roof, as shown on the transverse section, also making a double ceiling over a large part of the main hall, will greatly improve the building in that respect.

Also the thorough isolation and more complete ventilation of the lighting loft will relieve the main room of one very great trouble now existing, that is, the return of the air from the loft loaded with the products of combustion and escaping gas down over the galleries on to the floor of the house. By a series of experiments tried last year this was shown to be the constant action on three sides of the room.

It is believed that when these improvements are all made there will be but few days in the year when a forced ventilation (without the heating) would not be sufficient to keep the building comfortably cool.

The plans as submitted admit, however, of the most complete arrangement for cooling the air for ventilation. The cooling apparatus can be placed in the cellar near the eastern end, and the cooled air driven up the shaft left for that purpose, as shown on the plan, or, perhaps better, the whole apparatus could be placed in the attic over the corridors and stairway; and if ice was used, it could be hoisted up the place shown for that purpose; or if water was used for cooling, it could be pumped and used then.

Direct Admission of External Air and Sunshine to the Hall of Representatives.

The opinion seems very prevalent that there is an absolute necessity for the admission of the external air directly into the hall, as well as the direct rays of the sun, to give that freshness and vigor, as well as purity, to the contained atmosphere so desirable. There are, no doubt, good grounds for this opinion.

There have been propositions for very considerable structural changes, which would involve very great expense at the present high prices of labor and material.

The suggestions we make, however, are very simple, not interfering in any way with the construction, and, although perhaps not strictly architectural, but as they are so insignificant and kept below the line of the balustrade, they cannot be seen externally from any ordinary point of view.

But in this very simple manner we let in a large amount of additional light greatly needed on cloudy days, allow of the direct admission of an abundance of

fresh air from the very top of the building, which is much more desirable than at any point near the ground, and above all, allow of the admission of a very considerable amount of the direct rays of the sun.

Summary.

If the suggestions herein contained are carried out according to the accompanying plans, the following advantages will be gained:—

1st. A cool fresh invigorating air over the whole building in place of the warm over-heated debilitating stuff with which the building is now filled.

2d. A gentle, well-diffused warmth from direct radiation, which is entirely different from and superior to the warmth derived from currents of heated air.

3d. The feet and the backs of the occupants will be kept *really* warmer than their heads.

4th. The Hall of Representatives will be overflowed with an abundance of pure external air, with a much better light, and the admission of a considerable portion of the direct rays of the sun never before admitted since its completion.

5th. The whole apparatus for heating and ventilation will be very nearly self-acting, as it is so thoroughly distributed on the external sides of the buildings, no matter which way the air moves—north, south, east, or west, or up or down—the warmth is nearly uniform, as currents of air do not affect radiant heat.

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110 Broadway, N. Y., 3d mo. 16th, 1869.